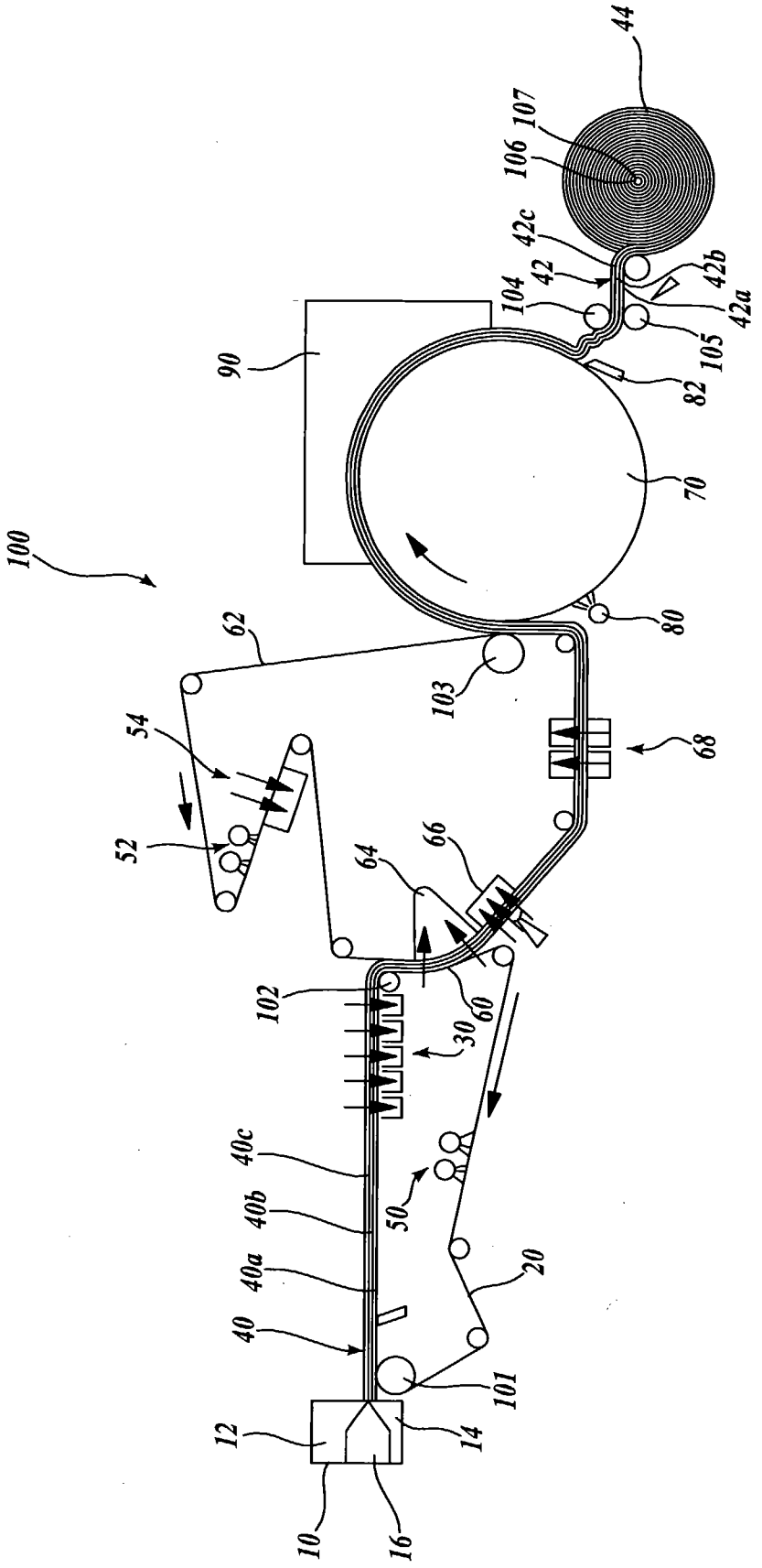
100
10
12
14
16
20
30
40
40a
40b
40c
42
42a
42b
42c
44
50
52
54
60
62
64
66
68
70
80
82
90
101
102
103
104
105
106
107

Fig.1.

Sample Number	NBSK	Inclusion Rate, %	Actual Refining Energy, kWh/mt	Kymene Addition, lbs./ton	CMC Addition, lbs./ton
199:100	PA Control	75%	40	25	4
199:101	PA Control	75%	53	25	4
199:102	PA Control	75%	27	25	4
199:105	PA Control	75%	27	40	0
199:115	PA Control	75%	27	10	8
199:120	PA Control	75%	53	40	4
199:125	PA Control	75%	27	10	0
199:130	PA Control	78%	108*	40	0
199:131	PA Control	78%	108	10	0
199:135	PA Control	66%	108	40	8
199:140	PA Control	66%	108	25	4
199:145	PA Control	75%	53	25	0
199:150	PA Control	75%	53	10	4
199:155	PA Control	75%	53	25	4
199:160	TR 962	75%	53	25	4
199:165	TR 962	75%	53	25	0
199:170	TR 963	75%	53	25	4

FIGURE 2

Sample Number	199:101	199:155	199:170
Pulp	Prince Albert	Prince Albert	TR963
Refining Energy Input, kWh/mt	53	53	53
CSF, ml	550	550	540
Calculated PFR, sec^2	12.1	12.1	12.4
Basis Weight, g/m^2	22.0	21.3	20.9
Bulk, $m^3/1000$ kg	16.0	17.0	17.0
Machine Direction (MD) Dry Tensile Index, Nm/g	13.03	11.78	13.38
Cross Machine Direction (CD) Dry Tensile Index, Nm/g	10.48	9.89	12.67
Square Root of MD*CD Tensile Index, Nm/g	11.69	10.79	13.02
MD Dry Tensile, N/m	287	251	280
CD Dry Tensile, N/m	231	211	265
Total Dry Tensile, N/m	518	462	545
MD/CD Tensile Strength Ratio	1.24	1.19	1.06
MD Stretch, %	17.8	18.4	18.3
MD TEA Index, J/kg	1189	1117	1263
CD Wet Tensile Index, Nm/g	3.05	2.90	3.21
CD Wet Tensile, N/m	67	62	67
CD Wet Tensile/CD Dry Tensile, %	29.0	29.4	25.3
Wet Burst Strength, g	211.0	205.4	247.2
Wet Burst Strength/Square Root MD*CD Tensile, in	0.32	0.34	0.37
Water Absorbency, g water/g sheet	7.4	7.4	7.1

FIGURE 3

Sample Number	199:135	199:160
Pulp	Prince Albert	TR962
NBSK Inclusion Rate, %	66	75
Refining Energy Input, kWh/mt	108	53
CSF, ml	480	460
Calculated PFR, sec^2	14.7	15.5
Basis Weight, g/m^2	21.4	22.6
Bulk, $m^3/1000$ kg	17.9	16.1
Machine Direction (MD) Dry Tensile Index, Nm/g	12.77	12.21
Cross Machine Direction (CD) Dry Tensile Index, Nm/g	11.67	11.5
Square Root of MD*CD Tensile Index, Nm/g	12.21	14.61
MD Dry Tensile, N/m	273	276
CD Dry Tensile, N/m	250	260
Total Dry Tensile, N/m	523	536
MD/CD Tensile Strength Ratio	1.09	1.06
MD Stretch, %	18.0	19.2
MD TEA Index, J/kg	1243	1163
CD Wet Tensile Index, Nm/g	3.67	3.31
CD Wet Tensile, N/m	78	75
CD Wet Tensile/CD Dry Tensile, %	31.2	28.8
Wet Burst Strength, g	272.4	263.4
Wet Burst Strength/Square Root MD*CD Tensile, in	0.40	0.32
Water Absorbency, g water/g sheet	7.5	7.2

FIGURE 4

Sample Number	199:101	199:155	199:145	199:160	199:165
Pulp	Prince Albert	Prince Albert	Prince Albert	TR962	TR962
CMC Addition Rate, lbs./ton	4	4	0	4	0
CSF, ml	550	550	550	460	520
Calculated PFR, sec^2	12.1	12.1	12.1	15.5	13.1
Basis Weight, g/m^2	22.0	21.3	20.7	21.8	22.6
Bulk, $m^3/1000$ kg	16.0	17.0	16.6	17.3	16.1
Machine Direction (MD) Dry Tensile Index, Nm/g	13.03	11.78	9.71	15.09	12.21
Cross Machine Direction (CD) Dry Tensile Index, Nm/g	10.48	9.89	8.25	14.15	11.5
Square Root of MD*CD Tensile Index, Nm/g	11.69	10.79	8.95	14.61	11.85
MD Dry Tensile, N/m	287	251	201	329	276
CD Dry Tensile, N/m	231	211	171	308	260
Total Dry Tensile, N/m	518	462	372	637	536
MD/CD Tensile Strength Ratio	1.24	1.19	1.18	1.07	1.06
MD Stretch, %	17.8	18.4	19.4	19.4	19.2
MD TEA Index, J/kg	1189	1117	934	1422	1163
CD Wet Tensile Index, Nm/g	3.05	2.90	2.06	3.72	3.31
CD Wet Tensile, N/m	67	62	43	103	75
CD Wet Tensile/CD Dry Tensile, %	29.0	29.4	25.1	33.4	28.8
Wet Burst Strength, g	211.0	205.4	139.3	263.4	206.3
Wet Burst Strength/Square Root MD*CD Tensile, in	0.32	0.34	0.29	0.32	0.30
Water Absorbency, g water/g sheet	7.4	7.4	7.6	7.6	7.2

FIGURE 5

Box-Behnken Design

Standard Order	Run Order	Block	Carboxyl Level meq/100g	Refined PFR sec2	Kymene lb/t	CMC lb/t	Type of Point
1	22	Block 1	4	7	35	2	Edge center
2	2	Block 1	16	7	35	2	Edge center
3	26	Block 1	4	13	35	2	Edge center
4	8	Block 1	16	13	35	2	Edge center
5	20	Block 1	10	10	20	0	Edge center
6	7	Block 1	10	10	50	0	Edge center
7	18	Block 1	10	10	20	4	Edge center
8	5	Block 1	10	10	50	4	Edge center
9	3	Block 1	4	10	35	0	Edge center
10	28	Block 1	16	10	35	0	Edge center
11	11	Block 1	4	10	35	4	Edge center
12	4	Block 1	16	10	35	4	Edge center
13	25	Block 1	10	7	20	2	Edge center
14	13	Block 1	10	13	20	2	Edge center
15	16	Block 1	10	7	50	2	Edge center
16	17	Block 1	10	13	50	2	Edge center
17	14	Block 1	4	10	20	2	Edge center
18	12	Block 1	16	10	20	2	Edge center
19	10	Block 1	4	10	50	2	Edge center
20	9	Block 1	16	10	50	2	Edge center
21	24	Block 1	10	7	35	0	Edge center
22	21	Block 1	10	13	35	0	Edge center
23	23	Block 1	10	7	35	4	Edge center
24	15	Block 1	10	13	35	4	Edge center
25	6	Block 1	10	10	35	2	Center
26	19	Block 1	10	10	35	2	Center
27	27	Block 1	10	10	35	2	Center
28	1	Block 1	10	10	35	2	Center
extra	29			7	35	0	
extra	30			7	35	0	

Data

Actual Carboxyl meq/100g	Dry Tensile g/in	Wet Burst g	Wet Burst /Dry Tensile	Bulk cc/g	Actual PFR sec2	WRV g/g
3	4774	1268	0.2656	3.87	7.7	1.99
12	4922	1456	0.2958	3.90	7.0	1.77
3	6482	1989	0.3068	3.12	18.1	2.27
12	6027	1902	0.3156	3.18	11.6	2.15
7	5734	1600	0.2790	3.39	10.6	2.08
7	5067	1680	0.3316	3.60	10.0	2.19
7	5915	1798	0.3040	3.36	8.6	2.14
7	5792	1856	0.3204	3.46	10.8	2.06
3	5563	1563	0.2810	3.47	12.8	2.16
12	6472	1929	0.2981	3.09	14.4	2.17
3	5760	1791	0.3109	3.33	12.3	2.07
12	5863	1880	0.3207	3.45	8.7	1.99
7	4201	1179	0.2806	4.14	6.0	1.79
7	5723	1795	0.3136	3.23	11.3	2.13
7	4625	1358	0.2936	4.04	6.8	1.95
7	6289	2216	0.3524	3.18	14.8	2.21
3	5786	1642	0.2838	3.54	10.8	2.08
12	5617	1593	0.2836	3.48	8.4	2.03
3	5444	1600	0.2939	3.45	12.7	2.17
12	6034	1923	0.3187	3.32	11.0	2.05
7	4500	1261	0.2802	4.01	7.0	1.90
7	6101	2032	0.3331	3.19	14.0	2.19
7	5125	1630	0.3180	3.85	6.6	1.84
7	6212	2019	0.3250	3.35	11.5	2.13
7	5718	1812	0.3169	3.45	10.5	2.01
7	6250	1970	0.3152	3.31	10.7	2.15
7	5890	1853	0.3146	3.37	10.5	2.09
7	5916	1765	0.2983	3.53	10.6	1.96
3	5076	1127	0.2220	3.74	8.3	1.91
12	5071	1453	0.2865	3.80	7.2	1.80

FIGURE 6

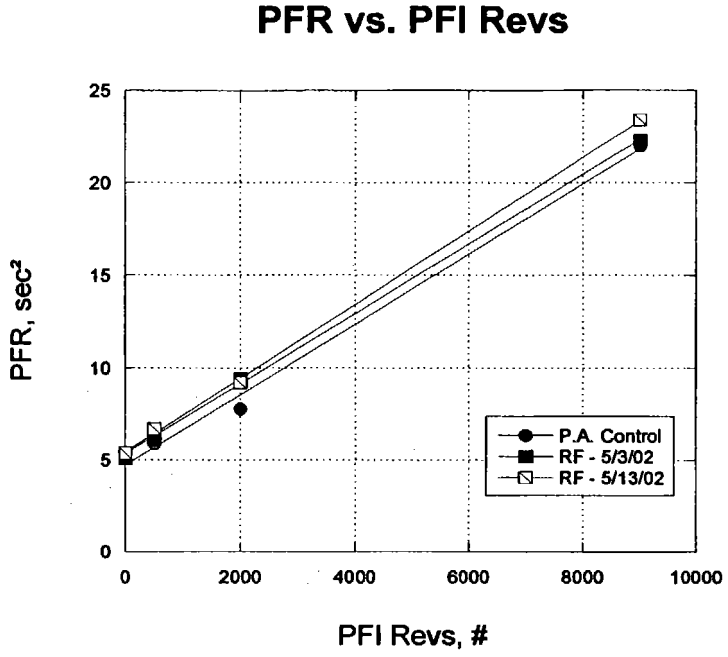
PFR vs. PFI Revs
PFR, sec²
PFI Revs, #
0
5
10
15
20
25
0
2000
4000
6000
8000
10000
P.A. Control
RF - 5/3/02
RF - 5/13/02

FIGURE 7

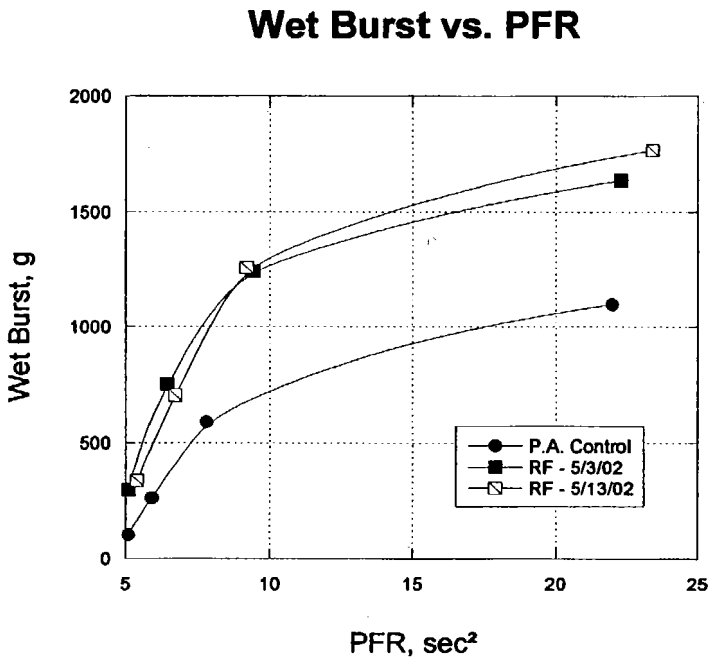
Wet Burst vs. PFR
Wet Burst, g
2000
1500
1000
500
0
5
10
15
20
25
PFR, sec²
P.A. Control
RF - 5/3/02
RF - 5/13/02

FIGURE 8

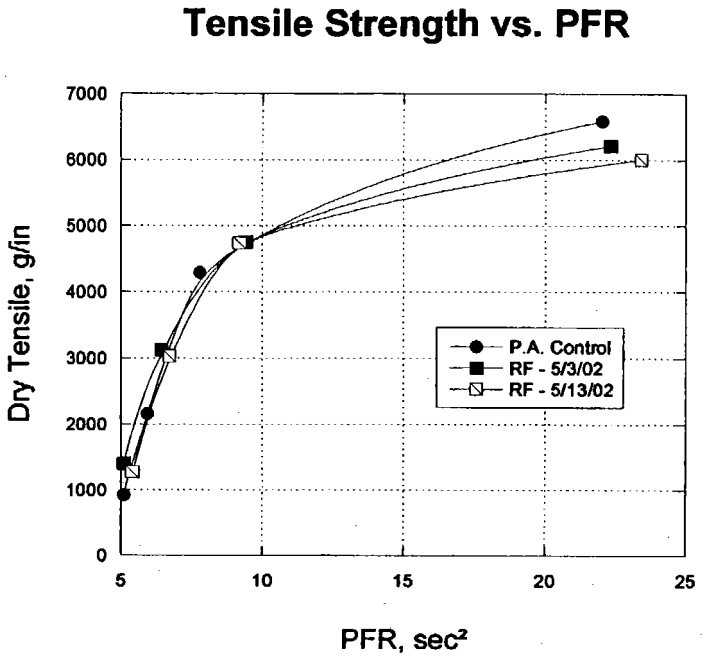
Tensile Strength vs. PFR
Dry Tensile, g/in
7000
6000
5000
4000
3000
2000
1000
0
5
10
15
20
25
PFR, sec²
P.A. Control
RF - 5/3/02
RF - 5/13/02

FIGURE 9

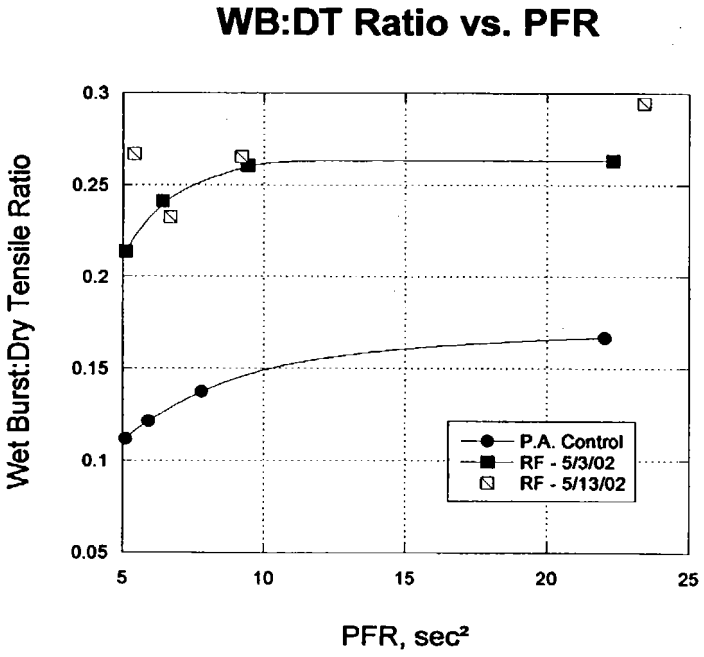
WB:DT Ratio vs. PFR
Wet Burst:Dry Tensile Ratio
0.3
0.25
0.2
0.15
0.1
0.05
5
10
15
20
25
PFR, sec²
P.A. Control
RF - 5/3/02
RF - 5/13/02

FIGURE 10

Run	Pulp	CSF	Kymene lbs./ton	CMC lbs./ton	BSWT g/m^2	Bulk cm^3/g	Wet Burst g	Tensile g/in.	WB/DT in.	WRV g/g
1	PA-Pilot Dried	475	25	4	26.9	3.647	1388	5091	0.273	1.774
2	Prince Albert	475	10	0	26.8	3.802	891	4415	0.202	
3	PA-Pilot Dried	575	25	8	26.7	3.651	1341	4750	0.282	
4	Carboxylated	375	40	4	27.0	3.354	1615	5619	0.287	
5	Prince Albert	475	40	8	26.3	3.725	1486	4929	0.301	1.802
6	Prince Albert	475	25	4	26.8	3.717	1334	4976	0.268	
7	Carboxylated	375	25	0	27.0	3.261	1332	5305	0.251	
8	Prince Albert	375	25	0	27.3	3.568	1047	4803	0.218	
9	PA-Pilot Dried	575	25	0	26.9	3.748	882	4086	0.216	
10	Carboxylated	475	25	4	27.0	3.427	1306	5113	0.255	1.711
11	Carboxylated	575	40	4	26.9	3.559	1258	4612	0.273	
12	PA-Pilot Dried	375	25	0	26.9	3.384	1324	5228	0.253	
13	Carboxylated	575	25	0	26.9	3.554	1071	4455	0.240	
14	PA-Pilot Dried	375	40	4	27.2	3.291	1578	5480	0.288	
15	Prince Albert	575	40	4	26.6	3.962	949	3965	0.239	
16	Carboxylated	475	10	8	26.7	3.253	1112	5217	0.213	
17	Prince Albert	475	10	8	27.3	3.609	1115	4714	0.237	
18	Prince Albert	375	25	8	26.7	3.577	1365	5418	0.252	
19	Carboxylated	475	40	0	27.2	3.465	1214	5167	0.235	
20	Carboxylated	475	40	8	26.7	3.384	1436	5333	0.269	
21	PA-Pilot Dried	475	25	4	24.9	3.669	1455	5349	0.272	1.758
22	PA-Pilot Dried	475	40	0	27.1	3.537	1081	4711	0.230	
23	Prince Albert	375	10	4	26.4	3.509	1143	5119	0.223	

FIGURE 11A

Run	Pulp	CSF	Kymene lbs./ton	CMC lbs./ton	BSWT g/m^2	Bulk cm^3/g	Wet Burst g	Tensile g/in.	WB/DT in.	WRV g/g
24	Carboxylated	575	10	4	27.0	3.455	945	4419	0.214	
25	PA-Pilot Dried	575	40	4	26.6	3.755	1139	4621	0.246	
26	PA-Pilot Dried	475	40	8	26.5	3.553	1488	5498	0.271	
27	Carboxylated	475	25	4	27.2	3.451	1298	5087	0.255	1.519
28	PA-Pilot Dried	475	10	8	27.0	3.425	1157	5259	0.220	
29	Prince Albert	475	25	4	27.2	3.726	1360	5013	0.271	1.839
30	Prince Albert	375	40	4	27.3	3.484	1411	5147	0.274	
31	PA-Pilot Dried	475	10	0	26.9	3.559	1089	4605	0.236	
32	Carboxylated	375	25	8	26.4	3.086	1517	5638	0.269	
33	Carboxylated	375	10	4	26.8	3.536	1069	5354	0.200	
34	PA-Pilot Dried	375	10	4	26.8	3.663	1207	5368	0.225	
35	Prince Albert	575	25	0	27.0	4.305	654	3303	0.198	
36	PA-Pilot Dried	375	25	8	26.9	3.626	1578	5546	0.285	
37	Carboxylated	575	25	8	26.7	3.722	1215	4560	0.266	
38	PA-Pilot Dried	475	25	4	26.7	3.855	1346	4949	0.272	1.734
39	Prince Albert	475	40	0	27.2	3.988	991	4274	0.232	
40	Carboxylated	475	25	4	27.1	3.652	1304	5084	0.257	1.741
41	PA-Pilot Dried	575	10	4	26.6	3.985	967	4458	0.217	
42	Prince Albert	575	25	8	26.8	4.245	1062	3956	0.268	
43	Prince Albert	475	25	4	27.2	3.973	1221	4734	0.258	1.752
44	Carboxylated	475	10	0	26.7	3.697	1005	4686	0.215	
45	Prince Albert	575	10	4	26.8	4.269	846	3766	0.225	

FIGURE 11B

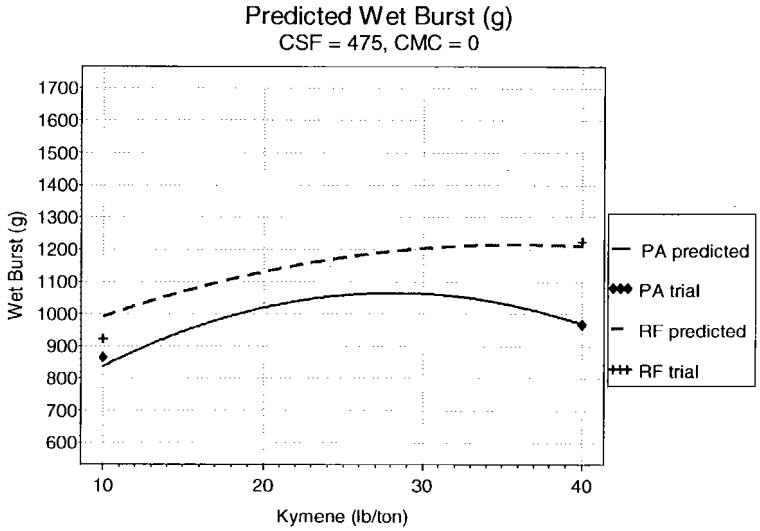

FIGURE 12A

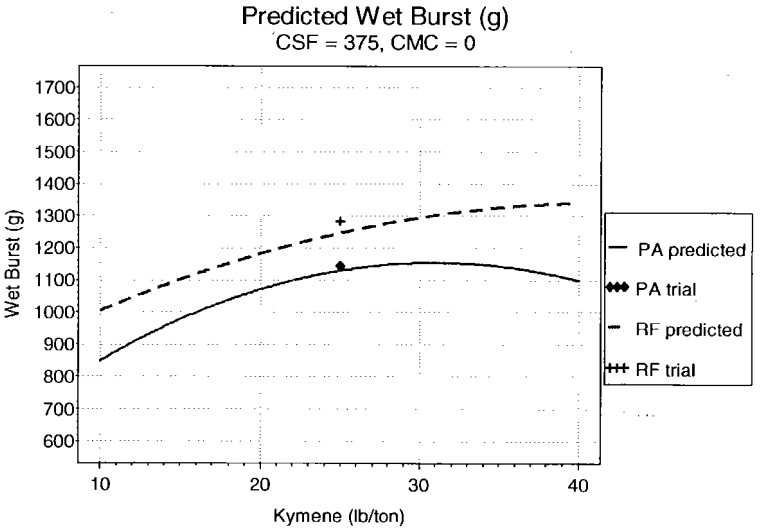

FIGURE 12B

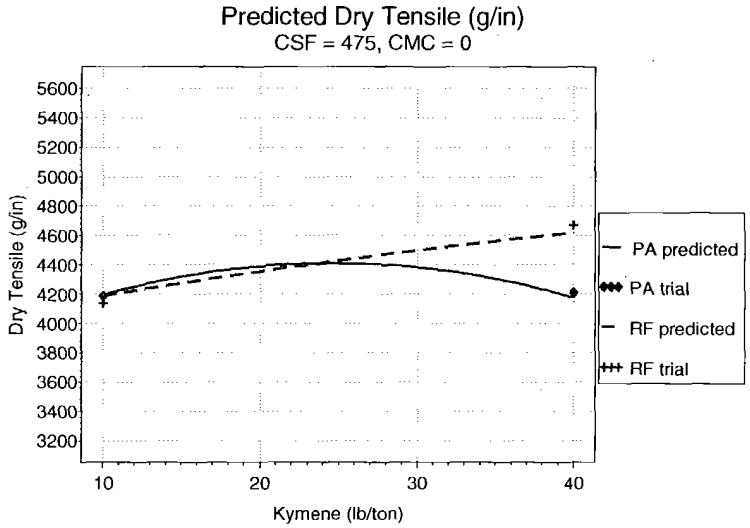

FIGURE 13A

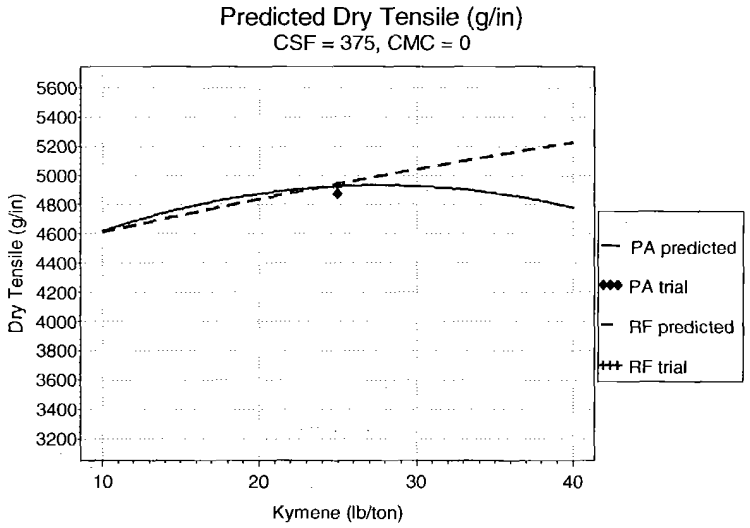

FIGURE 13B

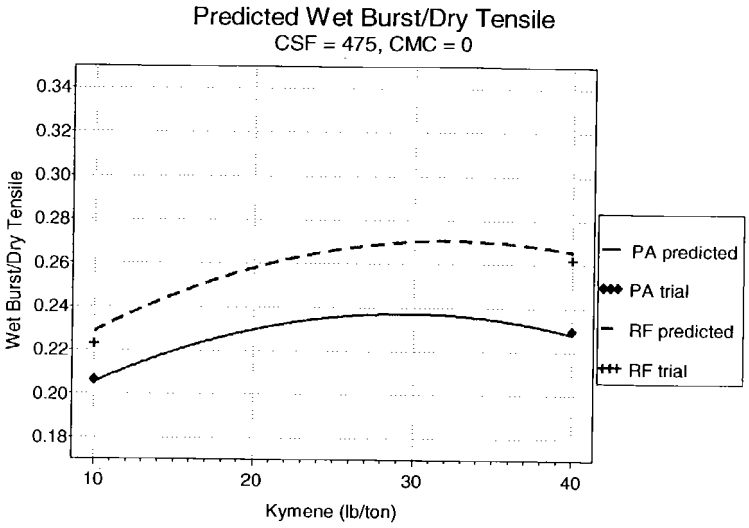

FIGURE 14A

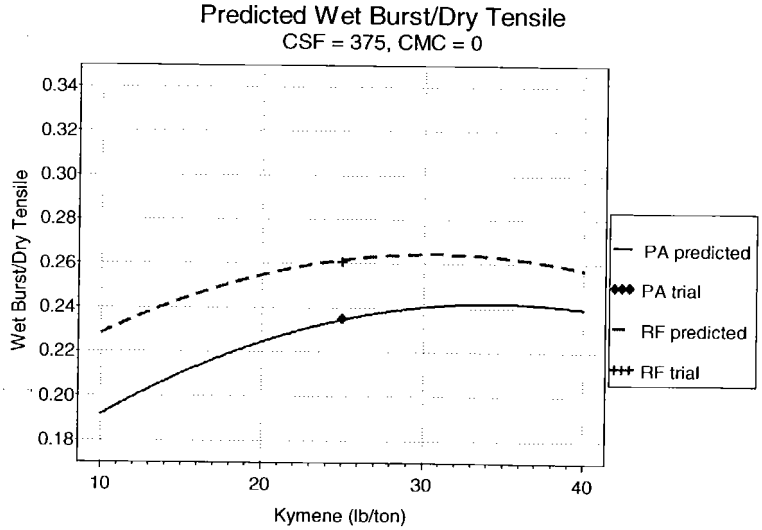

FIGURE 14B

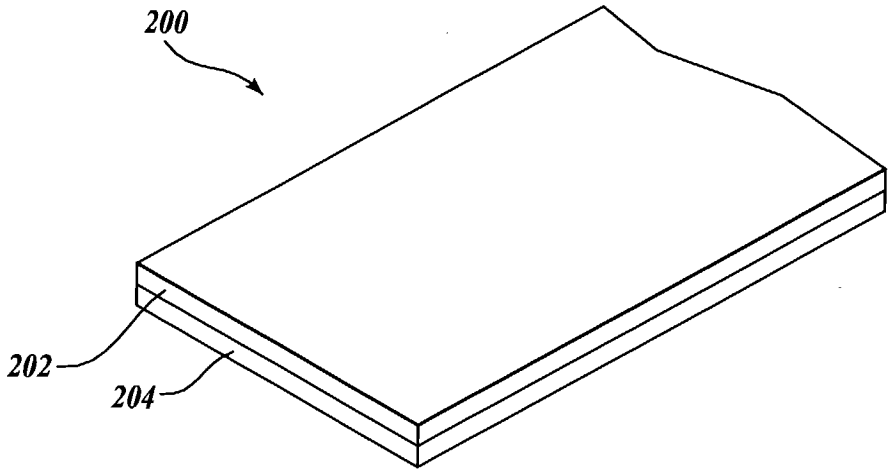

Fig.15A.

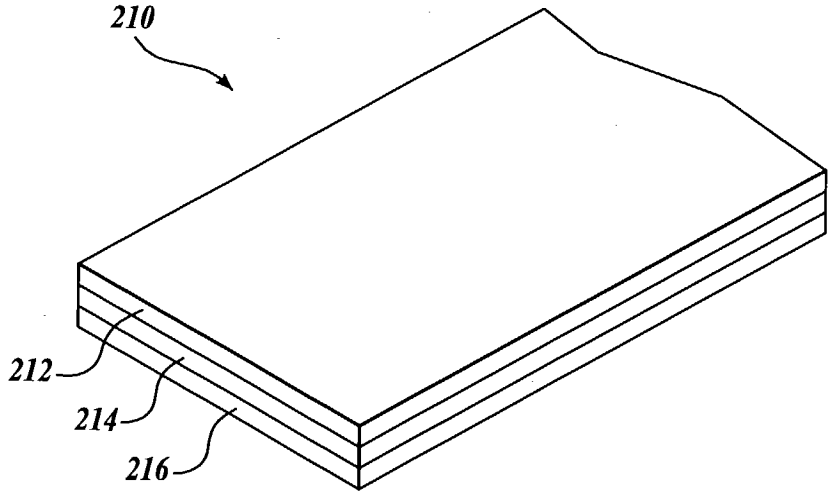

Fig.15B.